The Hedonic Haptics Player: A Wearable Device to Experience Vibrotactile Compositions

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Abstract
The Hedonic Haptics player is a portable wearable device that plays back vibrotactile compositions. It consists of three domes each of which houses a vibration motor providing vibrotactile sensations to the wearer. The domes are connected to a control unit the size of a small Walkman. The Hedonic Haptics player can store up to ten different compositions made up of haptic signals varying in amplitude, waveform and length. We use these different compositions to explore the aesthetic potential of vibrational haptics in an embodied wearable setup.

Author Keywords
Wearable Technology; Vibrotactile stimuli; Haptic Interfaces; Aesthetics.

ACM Classification Keywords
H.5.2 Information interfaces and presentation (e.g., HCI): Haptic I/O, Prototyping; H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
The Hedonic Haptics player is a portable wearable device that plays back up to ten different vibrotactile compositions. It is a design research artifact through

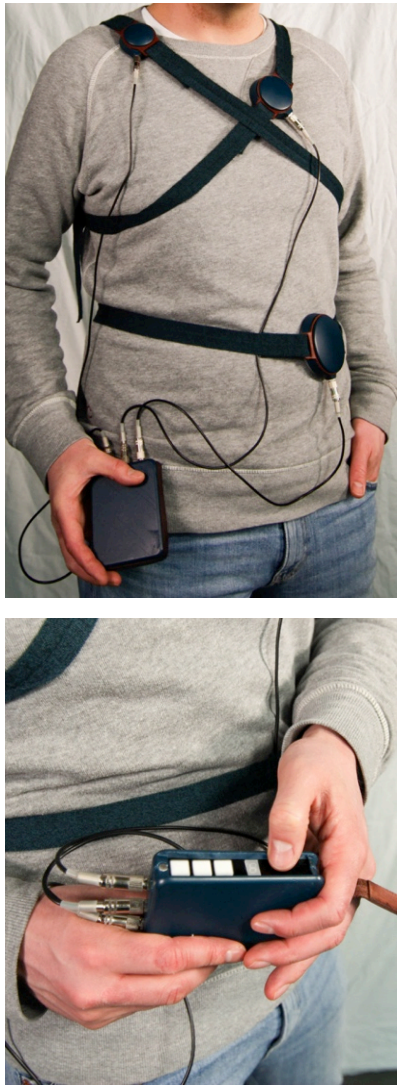

Figure 1: The Hedonic Haptics Player in use

which we explore the aesthetic potential of vibrotactile stimuli. With this device and study, we wish to go beyond the typical functional use of vibrations (e.g. as notifications) or as erogenous stimuli, into an underexplored design space where vibrotactile expressions can provide pleasurable experiences. As "function resides in the expressions of things" [2, p.166] we hope that by exploring and developing the design space of new expressions, our study will potentially lead to the development of new functions or creative use of technology at hand.

Related Hedonic Haptics

Vibrotactile stimuli that are intended to create *hedonic* experiences have been explored in other work, but typically their application is to augment other applications such as music or film. For example, Gunther and O'Modhrain [1] developed a suit that provides the wearer with haptic accompaniments of musical pieces by exaggerating or translating specific musical events to vibrotactile stimuli on specific parts of the body. In other projects, chairs are used as the basis form from which to provide the users with a haptic experience [cf. 3,5], where haptic stimulations are simple amplifications of the natural vibrations produced by the sounds/music. In other applications, vibration motors were integrated into gloves to enhance mood music in film [4]. Even though we believe these are all valuable and important explorations, it might become difficult to differentiate what role the haptics play in the overall experience of a multimodal interactive system.

The Hedonic Haptics Player Design

The Hedonic Haptic player is designed to exclusively focus on vibrotactile stimuli as a design material. It has a petroleum-colored encasing, with brown leather detail in both the domes and main unit. We purposely spent time and effort on the material appearance of the Hedonic Haptic player (See the pictorial in another part of the program, which presents an earlier version of the player), as the aesthetic experience involves the context of the experience including the appearance of the device and how it is worn (See Figure 1). Hence, we iteratively designed the physical appearance to deliberately mimic recognizable musical and wearable consumer products, as a means to set the scene of a hedonistic experience (See Figure 2).

The Domes

The haptic output is provided through three different sized domes - with diameters of 50, 60, and 80mm. Each dome is individually connected with an audio jack cable to the main unit. They comprise a 25 mm diameter eccentric mass vibration motor molded into a cylindrically shaped silicon mass, which in turn is housed in a 3D printed PLA shell. The enclosing shell has a fine circular notch that fits a 2 mm thick ring shaped leather. This leather ring is attached a band that is adjustable in length, to enable the wearer to position the dome on different places of their body.

The Main Unit

The 3D printed PLA main unit is dimensioned 100x80x24 mm and houses a Raspberry Pi, motor driver board and battery pack. Our current set-up works for 45 minutes to an hour of constant use until the battery runs out, yet also works when plugged in to a wall socket. The unit can be worn on the wearer's pocket or belt with a metal belt clip that is mounted on its backside. Three audio jack slots that each connect to a dome are positioned on the top of the unit, where the other controls for interaction are covered by a

Figure 2: The physical form of the Hedonic Haptics player. 50mm diameter sized dome (left) and main unit with controls for interaction exposed (right).

leather strip with a magnetic locking mechanism. These controls allow the selection of a vibrotactile composition with a back, forward and play button (See Figure 3). The selected composition is numerically represented on a 7-segment display, where a point light starts to blink when a composition is played. Next to these controls is a 'volume-control' that sets the amplitude of the vibration strength, to enable setting individually preferred intensities during the playback of a composition. The leather strip also covers more advanced controls on another side of the player, being an SD card slot for the Raspberry Pi to enable prototyping and inserting new compositions, and a socket for power supply and recharging the Hedonic Haptics player.

The Hedonic Haptics Compositions

Currently, we have designed three distinct compositions for the Hedonic Haptics Player which enables a first hand experience with some of the aspects of the vibrotactile design space (See Figure 4). In music we compose with rhythm, harmony, melody, dynamics, and timbre as basic building blocks. In haptic compositions like this one, we only have rhythms and dynamics to build from. The dynamic aspect comprises the static and time-varying amplitude of the haptic output, and the timing of events and the number and modulation of wave cycles generate the rhythms. As such, we are still able to create rather complex compositions. For instance, we use short high-amplitude pulses at regular intervals to create distinctive rhythmical composition and long low amplitude curved waveforms to form more ambient compositions. Currently, the system is based on a list of events that are executed sequentially to form an entire composition. Events are cycles of a pattern that repeat over a composition-dependent number of iterations. The nature of an individual event is determined by the application of weighted-random parameters at the time of creation. The choice for working with an aspect of randomness came from our early explorations where discernable repetition quickly became annoying and thus defies the pleasurable aim.

The Hedonic Haptics Experience

Our initial studies suggest that, for most, it takes about 10 min to get used to the unfamiliar experience. Before

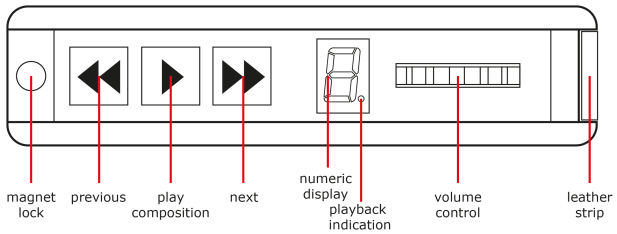

Figure 3: Buttons for selecting and playing/pausing a composition, and a volume control for vibration strength.

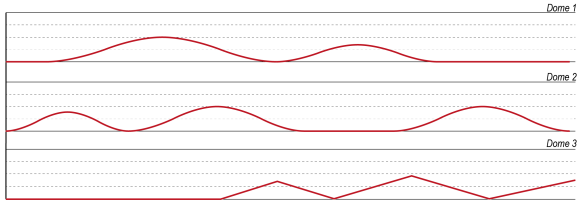

Figure 4: Example of the vibrotactile output for an 'ambient' composition

this threshold it reached most reports suggest a slight annoyance or stressful experience. However, when worn for a longer period, the familiarity allows for a more nuanced interpretation of the sensations. For instance, some report an experience of connection in and with the body. This happens particularly when a composition 'travels' between the domes and envelopes the wearer in the sensation. Or the device can be worn simply as an alternative to music, providing an embodied sense of ambient rhythms.

While the positive perception of the sensations apparently improves over time, we believe that the audience at DIS will still gain from the experience and interested parties can wear it for longer, or try it multiple times. We plan to bring two players enabling more than one trying them at the time.

Future Work

We are currently composing up to ten haptic compositions to populate a wider aesthetic design space. Our intention is to do a series of longitudinal studies with the device to see what improved familiarity with the sensation will provide. Through this we also hope to be able to develop a more nuanced language for this kind of vibrotactile sense of touch, as such language is not yet sufficiently developed [cf. 6]. Our initial studies suggest that there seems to be a fine balance between annoying alterity, relaxation and enjoyment, which we will set out to investigate in our further studies of hedonic haptics. Finding this balance could potentially lead to new areas of application, for example in areas such as meditative practices or vibrational therapy.

Video Link

https://vimeo.com/213694075

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